CLAIMS

What is claimed is:

1. A method for obtaining an assist torque to be applied to a human joint, in a human assist system for applying an assist torque to the human joint, comprising the steps of:

determining a gravity compensation control torque value for a first joint;

identifying said gravity compensation control torque as being feasible if the relative angular velocity between first and second segment of said first joint is substantially zero; and

identifying a gravity compensation control torque feasibility value when said relative angular velocity between said first and second segments of said first joint is not substantially zero, including the steps of:

determining a mechanical energy feasibility value of said gravity compensation control torque,

determining a metabolic energy feasibility value of said gravity compensation control torque, and

calculating said gravity compensation control torque feasibility value based upon said mechanical energy feasibility value and said metabolic energy feasibility value.

2. The method of claim 1, wherein said mechanical energy feasibility value represents a relationship between a value of an assisted muscle torque and a value of an unassisted muscle torque.

3. The method of claim 1, wherein said metabolic energy feasibility value represents a relationship between a value of a metabolic cost of assisted control and a value of a metabolic cost of unassisted control.

4. The method of claim 1, further comprising the step of:

determining a stability feasibility factor for said gravity compensation control torque.

5. The method of claim 4, wherein said step of calculating said gravity compensation feasibility value is based upon said mechanical energy feasibility value, said metabolic energy feasibility value and said stability feasibility factor.

6. The method of claim 5, further comprising the step of applying said gravity compensation feasibility factor when said gravity compensation feasibility factor value exceeds a first threshold.

7. The method of claim 1, further comprising the step of applying said gravity compensation feasibility factor when said gravity compensation feasibility factor value exceeds a first threshold.

8. A method for obtaining an assist torque to be applied to a human joint, in a human assist system for applying an assist torque to the human joint, comprising the steps of:

determining a gravity compensation control torque value for a first joint;

identifying said gravity compensation control torque as being feasible if the relative angular velocity between first and second segments of the said first joint is substantially zero; and

identifying a gravity compensation control torque feasibility value when the relative angular velocity between said first and second segments of the said first joint is not substantially zero, including the steps of:

determining a mechanical energy feasibility value of said gravity compensation control torque,

determining a stability feasibility factor for said gravity compensation control torque, and

calculating said gravity compensation control torque feasibility value based upon said mechanical energy feasibility value and said stability feasibility factor.

9. The method of claim 8, wherein said mechanical energy feasibility value represents a relationship between a value of an assisted muscle torque and a value of an unassisted muscle torque.

10. A method for obtaining an assist torque to be applied to a human joint, in a human assist system for applying an assist torque to the human joint, comprising the steps of:

determining a gravity compensation control torque value for a first joint;

identifying said gravity compensation control torque as being feasible if the relative angular velocity between first and second segments of of the said first joint is substantially zero; and

identifying a gravity compensation control torque feasibility value when said angular velocity between said first and second segments of the said first joint is not substantially zero, including the steps of:

determining a metabolic energy feasibility value of said gravity compensation control torque,

determining a stability feasibility factor for said gravity compensation control torque, and

calculating said gravity compensation control torque feasibility value based upon said metabolic energy feasibility value and said stability feasibility factor.

11. A system for obtaining an assist torque to be applied to a human joint, in a human assist system for applying an assist torque to the human joint, comprising:

means for determining a gravity compensation control torque value for a first joint;

first identifying means for identifying said gravity compensation control torque as being feasible if the relative angular velocity between first and second segments of said first joint is substantially zero; and

second identifying means for identifying a gravity compensation control torque feasibility value when the said angular velocity between said first and second segments of the said first joint is not substantially zero, including:

mechanical feasibility means for determining a mechanical energy feasibility value of said gravity compensation control torque,

metabolic feasibility means for determining a metabolic energy feasibility value of said gravity compensation control torque, and

first calculating means for calculating said gravity compensation control torque feasibility value based upon said mechanical energy feasibility value and said metabolic energy feasibility value.

12. The system of claim 11, wherein said mechanical energy feasibility value represents a relationship between a value of an assisted muscle torque and a value of an unassisted muscle torque.

13. The system of claim 11, wherein said metabolic energy feasibility value represents a relationship between a value of a metabolic cost of assisted control and a value of a metabolic cost of unassisted control.

14. The system of claim 11, further comprising:

stability feasibility means for determining a stability feasibility factor for said gravity compensation control torque.

15. The system of claim 14, wherein said first compensation means calculates said gravity compensation feasibility value based upon said mechanical energy feasibility value, said metabolic energy feasibility value and said stability feasibility factor.

16. The system of claim 15, further comprising application means for applying said gravity compensation feasibility factor when said gravity compensation feasibility factor value exceeds a first threshold.

17. The system of claim 11, further comprising application means for applying said gravity compensation feasibility factor when said gravity compensation feasibility factor value exceeds a first threshold.

18. A system for obtaining an assist torque to be applied to a human joint, in a human assist system for applying an assist torque to the human joint, comprising:

means for determining a gravity compensation control torque value for a first joint;

first identifying means for identifying said gravity compensation control torque as being feasible if the angular velocity of between first and second segments of the said first joint is substantially zero; and

second identifying means for identifying a gravity compensation control torque feasibility value when said angular velocity between first and second segments of said first joint is not substantially zero, including:

mechanical feasibility means for determining a mechanical energy feasibility value of said gravity compensation control torque,

stability feasibility means for determining a stability feasibility factor for said gravity compensation control torque, and

first calculating means for calculating said gravity compensation control torque feasibility value based upon said mechanical energy feasibility value and said stability feasibility factor.

19. The system of claim 18, wherein said mechanical energy feasibility value represents a relationship between a value of an assisted muscle torque and a value of an unassisted muscle torque.

20. A system for obtaining an assist torque to be applied to a human joint, in a human assist system for applying an assist torque to the human joint, comprising:

means for determining a gravity compensation control torque value for a first joint;

first identifying means for identifying said gravity compensation control torque as being feasible if the said relative angular velocity between the first and second segments connecting the said first joint is substantially zero; and

second identifying means for identifying a gravity compensation control torque feasibility value when the said relative angular velocity between said first and second segments connecting the said first joint is not substantially zero, including:

metabolic feasibility means for determining a metabolic energy feasibility value of said gravity compensation control torque,

stability feasibility means for determining a stability feasibility factor for said gravity compensation control torque, and

first calculating means for calculating said gravity compensation control torque feasibility value based upon said metabolic energy feasibility value and said stability feasibility factor.